SIN 351

Issue 5.1
November 2024

Suppliers' Information Note

For The Openreach Network

Openreach Public Switched Telephone Network (PSTN):

Technical Characteristics of The Single Analogue Line Interface and WITHDRAWAL NOTIFICATION

Each SIN is the copyright of British Telecommunications plc. Reproduction of the SIN is permitted only in its entirety, to disseminate information on the Openreach Network within your organisation. You must not edit or amend any SIN or reproduce extracts. You must not remove Openreach trademarks, notices, headings or copyright markings.

This document does not form a part of any contract with Openreach customers or suppliers.

Users of this document should not rely solely on the information in this document, but should carry out their own tests to satisfy themselves that terminal equipment will work with the Openreach network.

Openreach reserves the right to amend or replace any or all of the information in this document.

Openreach shall have no liability in contract, tort or otherwise for any loss or damage, howsoever arising from use of, or reliance upon, the information in this document by any person.

Due to technological limitations a very small percentage of customer interfaces may not comply with some of the individual characteristics which may be defined in this document.

Publication of this Suppliers' Information Note does not give or imply any licence to any intellectual property rights belonging to British Telecommunications plc or others. It is your sole responsibility to obtain any licences, permissions or consents which may be necessary if you choose to act on the information supplied in the SIN.
Those BT services marked ® indicates it is a registered trade mark of British Telecommunications plc.
Those services marked ™ indicates it is a trade mark of British Telecommunications plc.
This SIN is available in Portable Document Format (pdf) from:
https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do
Enquiries relating to this document should be directed to: orsinsfa@openreach.co.uk

Openreach logo are trademarks of British Telecommunications plc. © British Telecommunications plc 2024. Openreach Limited, Registered office: 6 Gracechurch Street, London EC3V 0AT.Registered in England and Wales no. 10690039

Contents

1. SCOPE 4

2. THE NETWORK TERMINATION POINT 4

2.1. CONNECTIONS USED IN OPENREACH MASTER SOCKETS 4
2.2. INSULATION DISPLACEMENT CONNECTORS 5
  2.2.1. Extension Wiring Connection *5*
  2.2.2. Gauge Of Conductors *5*

3. LINE CONDITIONS 5

3.1. OFF-LINE D.C. CONDITION 5
3.2. ON-LINE D.C. CONDITION 6
3.3. LINE POLARITY 6
3.4. NETWORK TERMINATION IMPEDANCE 6
  3.4.1. Terminal Input Impedance *7*
  3.4.2. Network Input Impedance *7*

4. SIGNALLING METHOD 8

4.1. MULTI-FREQUENCY TONE SIGNALLING 8
4.2. LOOP DISCONNECT SIGNALLING 9
4.3. RECALL 9

5. OUTGOING CALLS 9

5.1. CALL INITIATION 9
5.2. PROCEED INDICATION 9
5.3. CALL PROGRESS INFORMATION 10
5.4. CALL SET-UP TIME 10

6. INCOMING CALLS 10

6.1. CALL ARRIVAL INDICATION 10
6.2. CALLED CUSTOMER ANSWER 11
6.3. RING TRIP 11

7. CALL CLEARING 11

7.1. TERMINAL INITIATED CLEARING 11
  7.1.1. By The Calling Terminal *11*
  7.1.2. By The Called Terminal *11*
7.2. NETWORK INITIATED CLEARING 11
7.3. PARKED STATE 12

8. SUPERVISORY SIGNALS 12

9. ADDITIONAL INFORMATION 12

9.1. TRANSIENTS 12
9.2. ANNOUNCEMENTS 12
9.3. NOISE, INDUCED VOLTAGES AND LINE SURGES 12
9.4. HOWLER 13
9.5. END-TO-END INSERTION LOSS 13
9.6. LOSS/FREQUENCY RESPONSE 13
9.7. RELATIVE GROUP DELAY 14
9.8. TERMINAL EQUIPMENT SPECTRAL POWER REQUIREMENTS 14
9.9. LINE SHARING 15
9.10. SUPPLEMENTARY SERVICES 15
9.11. FOLLOW-ON CALL 15

10. ROUTINE TESTING OF THE LOCAL NETWORK 16

10.1. LINE TEST CONDITIONS 16
10.2. FUTURE PLANS 17
10.3. ENQUIRIES 18

11. GLOSSARY 18

12. REFERENCES 19

13. HISTORY 21

ANNEX A: CALL ARRIVAL INDICATION (RINGING) 23

ANNEX B: ANALOGUE DATA TRANSMISSION 25

ANNEX C: FURTHER SOURCES OF RELATED INFORMATION 26

1. Scope

This Suppliers' Information Note (SIN) specifies those technical characteristics of a single analogue line interface of the Public Switched Telephone Network (PSTN) provided by Openreach and known commonly as a Direct Exchange Line (DEL), without Supplementary Services, delivered to a customer at the Network Termination Point (NTP).

In cases where the Network Termination Equipment (NTE) is mains powered, the conditions quoted in this SIN apply when mains power is being applied to the NTE. The conditions applicable when mains power is removed from the NTE may be different to those quoted in this SIN.

Much of the information contained in this SIN has been published previously in documents such as ETSI Standards and British Standards.

Changes to the network that affect the correct working of terminal equipment designed to use the Openreach PSTN will be published in Openreach SINs. If the changes impact on the content of this document then it will be updated.

SINs are available from our www site at https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do

. Enquiries relating to the technical content of this document and the availability of SINs should be directed to orsinsfa@openreach.co.uk

Openreach will withdraw the single analogue line interface by the end of January 2027 in line with the closure of the BT UK PSTN.

2. The Network Termination Point

The Openreach network interface consists of two conductors designated as the ‘A’ and ‘B’ wires. The customer access to the Openreach network interface can be either a Openreach Master socket or in the form of an Insulation Displacement Connection (IDC) cable termination.

2.1. Connections Used In Openreach Master Sockets

When the line is terminated on a Openreach Master socket the connections are as shown in the following table.

Table 1: Openreach Master Socket Contacts

1	Not Used for PSTN
2	‘A’ wire or ‘B’ wire
3	Local earth when required
4	Shunt connection, when required
5	‘B’ wire or ‘A’ wire
6	Not Used for PSTN

Note 1: The shunt connection is derived from the centre point between a 470 kΩ resistor and a 1.8 μF capacitor connected in series across the ‘A’ and ‘B’ wires. Additionally there is an over-voltage protection device connected across the ‘A’ and ‘B’ wires.

Note 2: Contact pin 6 is adjacent to the latch.

Note 3: Plugs that meet the requirements of BS 6312:Part 1:1994 [1] and wired to correspond with Table 1 will be compatible with the BT provided socket.

2.2. Insulation Displacement Connectors

2.2.1. Extension Wiring Connection

Connections for internal extension wiring to IDC within Openreach PSTN NTE are shown in the following table.

Table 2: NTE IDC Connections for Extension Wiring

1	Not Used for PSTN
2	‘A’ wire or ‘B’ wire
3	Shunt connection (Bell wire)
4	Local Earth when required
5	‘B’ wire or ‘A’ wire
6	Not Used for PSTN

Note 1: The different types of NTE currently deployed within the Openreach network present from 3 to 6 IDCs for the termination of extension wiring, however, the essential connections, IDC '2', '3' & '5', will always be present and the numbering kept consistent.

Note 2: The numeric designation of IDCs and Master Socket contacts are not the same for each connection (see Section 2.1.), for example, the 'shunt connection' is presented on IDC '3' and at Master Socket contact '4'.

2.2.2. Gauge Of Conductors

Insulation Displacement Connectors (IDC) accept the connection of solid copper conductors between 0.4 mm and 0.63 mm diameter.

3. Line Conditions

3.1. Off-Line d.c. Condition

During the off-line state the Openreach network interface will provide the following conditions:

- The potential between the ‘A’ and ‘B’ wires will not exceed 70 V.
- The ‘A’ wire will be positive with respect to the ‘B’ wire.

- The Openreach network interface will recognise a loop resistance of greater than 10 kΩ between the 'A' and 'B' wires, on the customer side of the NTP, as an off-line condition.
- When a 100 kΩ resistor is connected across the Openreach network interface the potential between the 'A' and 'B' wires will be not less than 15 V.
- The off-line d.c. voltage may not be continuous e.g. during routine line testing (see section 11.1. Line Test Conditions) or during line testing in response to fault reports.
- The application of a resistance that causes less than 4 mA to flow will not be recognised as an on-line ('seize') condition.
- There may not be a through metallic path from the BT network interface to the exchange so that the "battery" and "earth" at the exchange cannot be assumed to be repeated at the Openreach network interface.
- The conditions applied during automatic line testing routines (*see section 11 Routine Testing Of The Local Network*).

3.2. On-Line d.c. Condition

During the on-line state the Openreach network interface will provide the following conditions:

- The BT network interface will recognise a loop resistance of less than 1 kΩ between the 'A' and 'B' wires, on the customer side of the NTP, as an on-line ('seize') condition.
- The d.c. current provided at the customer side of the NTP will be up to 42 mA at 12.5 V, up to 33.5 mA at 10 V, and will be not less than 25 mA at 9 V.*

Future designs of the line interface will aim to reduce the line current in the on-line state to improve the energy efficiency of Openreach's network equipment. Some of these line interfaces are already deployed on a relatively small scale and as a result the line current on these lines will become 25 mA in the on-line state for all the voltage values specified in this clause. The wider deployment of such line interfaces in the future will be considered by Openreach as the need or opportunity arises to replace or update existing equipment.

3.3. Line Polarity

The polarity of the Openreach network interface will normally be such that the 'B' wire is more negative than the 'A' wire. A configurable option exists to reverse the polarity of the calling terminal's 'A' and 'B' wires once a call is 'answered', after which the polarity will remain in this state for the duration of the call.

3.4. Network Termination Impedance

---

* These characteristics are aligned with those of ETS300 001, Chapter 2 Figure 2.3 (GB) [4].

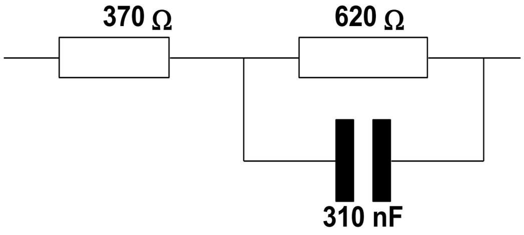
3.4.1. Terminal Input Impedance

The impedance necessary to satisfactorily terminate the Openreach network interface at the NTP so as to prevent instability is represented by the three-element network shown in Figure 1.

A minimum return loss of 12 dB should be achieved by terminal equipment against the three-element network of Figure 1.

Additionally for voice terminal equipment, an echo return loss value of 16 dB should be achieved against the three-element network of Figure 1.

Figure 1: Terminal Complex Impedance Network



3.4.2. Network Input Impedance

The input impedance of the network at the NTP is represented by a range of impedances comprising the input impedance of the local exchange, modified by the impedance of a random variety of local cable types/characteristics.

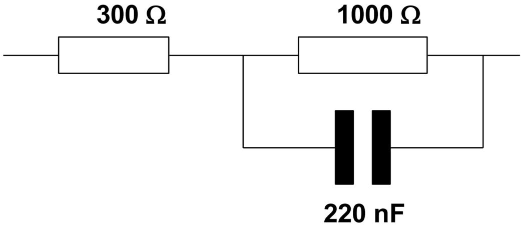
The nominal exchange input impedance is 300 Ω + 1000 Ω || 220 nF (*see Figure 2*).

This may be regarded as the appropriate value for use by terminal designers.

The actual value of the exchange input impedance may vary due to production and installation tolerances, also the impact of terminal equipment connected at the far end of the circuit on the performance of circuits containing 4-wire loops. A worst case return loss of 16 dB against the three-element network of Figure 2 can be assumed.

The range of local lines can be represented by between 0 km and 9 km of 0.5 mm copper cable with nominal characteristics of 168 Ω/km and 50 nF/km (attenuation at 1600 Hz of 1.7 dB/km).

Figure 2: BT Network Complex Impedance Network



4. Signalling Method

The Openreach network interface will respond to signalling information received from the terminal, either in Multi-Frequency Tone format or Loop Disconnect format.

4.1. Multi-Frequency Tone Signalling

The Openreach network interface will recognise tones meeting all of the following conditions as valid digits:

- multi-frequency tones conforming to Table 3, each digit being represented by simultaneous transmission of two frequencies e.g. digit 5 is indicated by 770 Hz + 1336 Hz, and
- combinations of the frequencies given in Table 3 where the tolerance is within ± 1.5 % and the level is within -7 dBm to -13 dBm and with the high frequency at a higher level than the low frequency by between 1 dB and 4 dB, and
- tones that have been applied for a minimum period of 40 ms and with a minimum "tone off" period of 40 ms, and
- the level of any individual unwanted tone in the frequency band 300 Hz to 3,400 Hz has a power level of less than -33 dBm, and
- tones whose accompanying power level outside the frequency band 300 Hz to 3,400 Hz is less than -40 dBm, and
- tones whose accompanying total in-audio-band and out-audio-band unwanted tone power levels are 20 dB less than the lowest power level of any single digit tone.

Table 3: Digit Tone Frequencies

Digits			Low
1	2	3	*697 Hz*
4	5	6	*770 Hz*
7	8	9	*852 Hz*
*	0	#	*941 Hz*

High	*1209*	*1336*	*1477*

4.2. Loop Disconnect Signalling

The Openreach network interface will recognise as valid loop disconnect pulses meeting all of the following conditions:

- loop disconnect digits at the rate 10 ± 1 pulses per second where the ratio of the break period is 67 +5, -4 % of the overall pulse period, and
- Inter Digit Pauses greater than 240 ms and less than 920 ms, and
- a **break pulse** as a reduction in line current to less 500 μA for a minimum duration of 15 ms, and
- a **make pulse** with a minimum duration of greater than 5 ms, and
- with a pulse shape equivalent to that produced by the shaping circuit of 100 Ω in series with 1.8 μF when subjected to a voltage of between 1 V and 12.5 V (*see Figure 3: Pulse Shaping Circuit*).

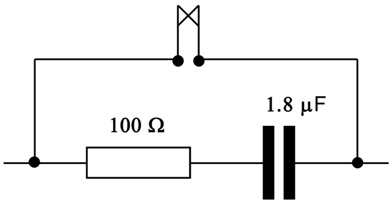


Figure 3: Pulse Shaping Circuit

4.3. Recall

When a call is in the on-line answered state, the Openreach network interface will recognise a reduction of the loop current to 1 mA or below, for a period in the range of 53 ms to 103 ms, as a Recall signal.

Note: The Recall signal is used for the control of Supplementary Services as described in SIN 354 [2].

5. Outgoing Calls

5.1. Call Initiation

The Openreach network interface will respond to the application of an on-line ('seize') condition (*see section 3.2 On-line d.c. Conditions*) that persists for at least 10 ms. After recognition of the call initiation signal by the exchange, Proceed Indication (*see section 5.2 Proceed Indication*) will be returned to the calling customer within 500 ms.

5.2. Proceed Indication

When the Openreach network interface is ready to receive routeing information a Proceed Indication (Dial Tone) will be provided to the calling terminal.

This tone is described in SIN 350 [3] Network Tones and Announcements.

5.3. Call Progress Information

During the progress of a call, a variety of tones and announcements may be encountered. Lists of these are to be found in SIN 350 [3] Network Tones and Announcements.

5.4. Call Set-Up Time

The call set-up time figures given below relate to calls routed wholly within the Openreach network. Calls that are routed outside the Openreach network (e.g. extended to mobile numbers, into private networks or via direct dialling in lines) may experience longer post dialling delays.

The mean value of call set-up time across the Openreach network is expected to be less than 3 seconds, when taking into account the differing levels of call complexity. In addition, 95% of calls are expected to be set up in less than 10 seconds.

6. Incoming Calls

6.1. Call Arrival Indication

Where appropriate, the Openreach network interface will provide call arrival indication to any off-line terminal as shown in annex A: Call Arrival Indication (Ringing).

The voltage of the call arrival indication at the NTP will be between 100 V and 40 V a.c. r.m.s as measured between the 'A' wire and the 'B' wire. A Ringer Equivalence Number (REN - as defined in ETS 300 001, Chapter 3 Section 3.1 (GB) [4]) of 4 will be supported.

> Note. There is currently a relatively small scale deployment of a version of the line interface design that applies the a.c. call arrival indication voltage across the 'A' wire and 'B' wire, rather than across the 'B' wire and earth. The wider deployment of such line interfaces in the future will be considered by BT as the need or opportunity arises to replace or update existing equipment.

Call Arrival Indication may be presented with or without a d.c. voltage bias (*within the limits specified in section 3.1 Off-line d.c. Condition*) on the 'A' wire, the 'B' wire, or both. When Call Arrival Indication is presented with a d.c. voltage, this d.c. voltage may be present during the whole cadence or may be confined to the silent periods. The polarity of this d.c. voltage may be reversed.

Distinctive ringing may be provided when certain supplementary services are invoked. These services are described in SIN 354 [2].

Call arrival indication is applied for up to 6 minutes or until the called customer answers.

6.2. Called Customer Answer

The Openreach network interface will recognise the application of the on-line d.c. condition of section 3.2 as a called party answer, and disconnect ringing.

6.3. Ring Trip

In normal operation ringing current may continue to be applied for typically 110 ms to 510 ms after the on-line state is established.

7. Call Clearing

Note: Except where stated, the following call clearing conditions are written on the assumption that both ends of the call are connected to a single analogue line interface and the call is connected wholly within the BT network.

7.1. Terminal Initiated Clearing

7.1.1. By The Calling Terminal

When a call is ended by the calling terminal, the Openreach network interface will detect an off-line condition (*see section 3.1 Off-Line d.c. Condition*) and provide the network initiated clearing *(see section 7.2 Network Initiated Clearing*) to the called terminal. Line breaks of less than 200 ms will not be recognised as a clear. Line breaks greater than 3 s will be recognised as a clear (*see section 10.1 Follow-on Call*).

7.1.2. By The Called Terminal

When a call is ended by the called terminal, the Openreach network interface will detect an off-line condition *(see section 3.1 Off-line d.c. Condition*) and initiate a time-out process lasting between two and three seconds. After the time-out period has expired, network initiated clearing (*see section 7.2 Network Initiated Clearing*) is provided to the calling terminal.

Calls that are made to certain services (e.g. Number translation services and Premium rate services) are subject to first party clearing. In these circumstances, when the called terminal ends the call there is no time-out process and the calling terminal is provided with network initiated clearing (*see section 7.2 Network Initiated Clearing*) immediately.

7.2. Network Initiated Clearing

The Openreach network interface will provide a sequence of clearing signals at the NTP as a result of terminals ending a call or when terminals fail to present valid digits during call set-up.

This will consist in any order of:

a) an 'end-of-call' signal of between 90 ms and 130 ms and/or;

b) number unobtainable tone lasting between 3 s and 20 s and/or;

(Number unobtainable tone is described in SIN 350 [3] Network Tones and Announcements)

c) silence lasting between 0 s and 30 s;

and will end with the Parked State (*see section 7.3 Parked State*).

Note 1: The ‘end-of-call’ signal is sometimes known as the “K-break” signal. It offers a positive way for automatic terminal equipment to determine when either a calling terminal or the BT network interface has resumed the off-line condition. The signal consists of a disconnection or a reduction in the loop current to below 1 mA for the time period stated.

Note 2: There are certain interfaces supported by non-copper access systems that cannot provide the ‘end-of-call’ signal.

7.3. Parked State

When a terminal remains on-line, and has failed to offer a valid digit (*see section 5.1 Call Initiation*) or has failed to achieve the off-line state after call clearing (*see section 7 Call Clearing*), the BT network will monitor the line so that a terminal clear condition can be detected. It some circumstances an automatic howler might be applied (*see section 9.4 Howler*).

8. Supervisory Signals

Supervisory signals provided at the Openreach network interface are described in SIN 350 [3] Network Tones and Announcements.

9. Additional Information

9.1. Transients

Change of line conditions (for example, polarity, voltage, speech band levels, feeding resistances, and current interruptions) may occur during processing of a call by the network.

9.2. Announcements

At various stages of calls it is possible for announcements to be connected. Announcements are described in SIN 350 [3] Network Tones and Announcements.

9.3. Noise, Induced Voltages and Line Surges

The Openreach network interface conditions described in this SIN are those encountered when there is no interference and the earth potential at the local exchange and the NTP is the same. In practice these conditions may be modified as follows.

Permanent longitudinal direct voltages up to 4 V may exist on the line.

Permanent longitudinal alternating voltages up to 5 V r.m.s. 50 Hz, and associated harmonics, may exist on the line. Additionally there may be an earth potential difference up to 3 V r.m.s. 50 Hz.

Permanent longitudinal and transverse alternating voltages, which generally do not exceed 3 V r.m.s., at other frequencies up to 2 MHz may exist on the line.

These are generally noise voltages, but between 200 kHz and 2 MHz they may be amplitude modulated and be as a result of radio broadcast signals.

Uniform spectrum and random noise having a power of -42 dBm in the frequency range 300 Hz to 3400 Hz may exist on the line, with random impulsive noise in excess of -22 dBm. Also, other types of random transmission impairment may occur, such as interruptions, phase changes, phase jitter and gain changes.

9.4. Howler

Table 4: Howler Characteristics

Significance	Range of levels received at BT network interface	Signal composition	Cadence
To draw attention to a telephone left on-line. May be applied to attachments which hold after the distant end has cleared or after an unsuccessful call The howler can sometimes be applied automatically, in which case it will start 3 minutes after the parked state has been achieved.	Applied initially at mean power level of up to -8 dBm rising over 12 s to +15 dBm; total max. power +20 dBm	Multi-audio frequency	Continuous for 3 minutes or until line release if this occurs first

9.5. End-To-End Insertion Loss

The end to end insertion loss at 800 Hz between 600 Ω resistances terminating two BT network interfaces and routed wholly within the BT network is between 6 dB and 30 dB.

Note 1: These values apply only to calls where both ends are connected to a single analogue line interface and the call is connected wholly within the Openreach network.

Note 2: Local line attenuation that exceeds 10 dB at 1600 Hz will be compensated within the local exchange so that the attenuation planning limit of 10 dB is not exceeded. However this does not compensate for the 'additional' loss/frequency distortion.

9.6. Loss/Frequency Response

The loss/frequency response of Openreach's core network connecting its local exchanges conforms to ITU-T G.712 [5]: Figure 3.

Table 5: Core Network 2-wire to 2-wire Insertion Loss/Frequency Response

Frequency (Hz)	10	200	300	400	600	2400	3000	3400	3600	4000
Response (upper) (dB)	40	40	2	1.5	0.7	0.7	1.1	3	40	40
Response (lower) (dB)	0	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	0

Additionally, any connection will usually contain two local lines comprising a random variety of cable types/characteristics.

The nominal loss/frequency response limits of the range of local lines can be represented by between 1 km and 9 km of 0.5 mm copper cable with nominal characteristics of 168 Ω/km and 50 nF/km (attenuation at 1600 Hz of 1.7 dB/km) and are shown in Table 6.

Table 6: Local Network Cable Insertion Loss/Frequency Response

	Insertion Loss (dB)				
Frequency (Hz)	200 Hz	400 Hz	1600 Hz	3200 Hz	4000 Hz
Upper limit (dB)	5.1	7.1	14.2	20.1	22.5
Lower limit (dB)	0.4	0.6	1.2	1.7	1.9

Note: ***Values applicable to end to end characteristics apply only to calls connected wholly within the BT network when measured between 600 Ω resistances.***

9.7. Relative Group Delay

With the advent of the wholly digital core Openreach network, relative group delay has become less of a significant parameter in relation to the transmission of voiceband data.

9.8. Terminal Equipment Spectral Power Requirements

To prevent undue interference with other users of the Openreach access network, terminal equipment should conform to the requirements of the "Specification of the Access Network Frequency Plan (ANFP) applicable to transmission systems used on the Openreach Access Network". This ANFP specifies Power Spectral Density masks (PSD) defining the maximum power for each frequency that may be injected into the line at the customer end of the local loop. Customers are advised to contact their terminal equipment provider on this issue to ascertain the compliance of their terminal equipment with the ANFP. SIN 375 [6] gives up to date information about the ANFP PSD masks, and where to locate the latest issue of the ANFP specification.

If interference is caused to other users of the Openreach access network, and this is identified as resulting from terminal equipment being non-compliant with the ANFP, Openreach will be required to take remedial action to remove the cause of the interference. This could ultimately result in the disconnection of the PSTN circuit from the non-compliant terminal equipment.

Equipment that has been approved under the UK terminal equipment approval regime that existed prior to the implementation of the RE&TTE Directive [7], which is transposed into UK law by SI 2000 No. 730 [8] and SI 2003 No. 1903 [13], is deemed to be compliant with the ANFP.

Home Phoneline Networking (HPN) equipment [i] (e.g. equipment designed to ITU-T Recommendation G.989.1 [9], Phone-line Networking Transceivers - Foundation) is likely to be compliant to the ANFP provided that the optional isolation filter that is strongly recommended in Recommendation G.989.1 is fitted to prevent the signals from the Home Phoneline Networking equipment leaking out via the PSTN NTP onto the Openreach access network.

9.9. Line Sharing

Where the Openreach exchange line is shared with another Provider of Electronic Communications Networks providing Asymmetric Digital Subscriber Line services or Generic Ethernet Access the Openreach services listed in SIN 346 [10] clause 2 will not be available. Where the line is shared and CPE ADSL filters are required (see SIN 346 [10]) or VDSL CPE filters are required (See SIN 498[15], the characteristics of the Openreach network interface will be such that the interface characteristics described in this SIN will apply when:-

1. A CPE ADSL filter compliant with clause 7 of SIN 346 is connected to the Openreach network interface OR
2. A CPE VDSL filter compliant with section A.4.2.6 of SIN 498 is connected to the Openreach network interface.

9.10. Supplementary Services

Supplementary Services are described in SIN 354 [2] Supplementary Services available on the Analogue Line Interface.

9.11. Follow-On Call

---

[i] Equipment using customer premises extension telephone wiring to provide an internal data network within the customer's premises.

To initiate a follow-on call the Openreach network interface will recognise a break in the loop current applied at the NTP, where the d.c. current falls to 1 mA or less for a time period in excess of 3 s.

10. ROUTINE TESTING OF THE LOCAL NETWORK

Openreach has for many years carried out automatic test routines on its local line plant. In recent years the frequency of testing PSTN lines has increased to a level approaching once every 24 hours in order to maintain the high levels of customer service expected of a modern network.

In the early 1990's problems were encountered with telephone bells or tone callers responding to the line conditions arising from these tests. To address this problem SIN 156 was published that outlined the conditions that might be expected during routines and as a result significant improvements have been made to apparatus that have almost eliminated the problems.

The following information replaces SIN 156 and is to maintain awareness of the need to consider the effect of Openreach's test routines during the design of new apparatus to avoid consumer dissatisfaction.

The Line Test Systems operated by Openreach are of proprietary origin, the technical design of which is the Intellectual Property of the vendors. However the following information is representative of the conditions that may be expected and should be considered during the design of new apparatus.

10.1. Line Test Conditions

The conditions below may be applied in accordance with table 7.

a) Up to 50 Volt battery (Positive and Negative with respect to earth) with a source resistance between 0 and 120 kΩ;
b) Earth via a source resistance of between zero and 120 kΩ;
c) Open circuit greater than 10 MΩ;
d) AC voltage to be less than 25 volts peak to peak at no more than 30 Hz, either balanced or longitudinal.

The sequence of these conditions is not as important as the control of transients while switching between tests. The following general conditions apply.

i) Exchange voltage disconnected;
ii) Transient current limited to 1.0 mA while switching between tests;
iii) Transient settling time between tests of up to 1 second;
iv) Total test time of up to 18 seconds;
v) Exchange voltage reconnected.

Table 7: Line Test Conditions

'A' Wire	'B' Wire
Earth	Battery
Battery	Earth
Open	Battery
Battery	Open
Open	Earth
Earth	Open
Battery	Battery
Earth	Earth
Open	Open
AC	Battery
Battery	AC
Earth	AC
AC	Earth
AC	Open
Open	AC
AC	AC

10.2. Future Plans

Openreach is evaluating the use of automatic test routine equipment that removes the off-line d.c. voltage for a period of greater than the 18 second period described in 10.1 Line Test Conditions. If it is decided to deploy such equipment then this SIN will be re-issued to give advance notice of any changes to the characteristics described in 10.1.

10.3. Enquiries

Contact details for enquiries about routine testing of the local network can be found at

https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do

11. Glossary

ADSL	Asymmetric Digital Subscriber Line
ANFP	Access Network Frequency Plan
DEL	Direct Exchange Line
DP	Distribution Point
EC	European Commission
ETSI	European Telecommunications Standards Institute
HPN	Home Phoneline Networking
IDC	Insulation Displacement Connector
NTE	Network Termination Equipment
NTP	Network Termination Point
REN	Ringer Equivalence Number
PSD	Power Spectral Density
PSTN	Public Switched Telephone Network
RE&TTE	Radio Equipment and Telecommunications Terminal Equipment
SI	Statutory Instrument
SIN	Suppliers' Information Note
TIG	Technical Interface Guide

12. References

[1]	British Standards document BS6312, 1994 - Connectors for analogue telecommunication interfaces. Part 1. Specification for plugs
[2]	SIN 354 - BT Public Switched Telephone Network (PSTN):Technical Characteristics of The Supplementary Services Available On The Analogue Line Interface.
[3]	SIN 350 - BT Public Switched Telephone Network (PSTN): Network Tones And Announcements.
[4]	ETSI ETS 300 001, 4th Edition January 1997. Attachments to Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to an analogue subscriber interface in the PSTN.
[5]	ITU-T Recommendation G.712, 11/96 - Transmission performance characteristics of pulse code modulation channels.
[6]	SIN 375 – Terminal Equipment Spectral Power Requirements.
[7]	RE&TTE Directive - Directive 1999/5/EC of the European Parliament and of The Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity, OJ L91, 7.4.1999, p.10.
[8]	Statutory Instrument 2000 No. 730. The Radio Equipment and Telecommunications Terminal Equipment Regulations 2000.
[9]	ITU-T Recommendation G.989.1, 02/01 - Phone-line Networking Transceivers – Foundation.
[10]	SIN 346 - BT ADSL Interface Description.
[11]	ITU-T Recommendation V.90, 09/98 - A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream.
[12]	ITU-T Recommendation V.34, 02/98 - A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits.
[13]	Statutory Instrument 2003 No. 1903. The Radio Equipment and Telecommunications Terminal Equipment (Amendment) Regulations 2003
[14]	Statutory Instrument 2003 No. 1904. The Electronic Communications (Universal Service) Order 2003
[15]	SIN 498 - Generic Ethernet Access Fibre to the Cabinet (GEA-FTTC) Service and Interface Description

For further information or copies of referenced sources, please see document sources at https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do

13. History

TIG 1 Issue 1	October 1997	Originally published as Technical Information Guide 1.
TIG 1 Issue 2	October 1998	Major revision.
SIN 351 Issue 1.0	March 2001	Document re-issued as SIN 351 with editorial changes. Statements on ANFP, HPN, and the information previously published in SIN 156 on Routine Testing Of The Local Network added. '± 1.5 Hz' corrected to '± 1.5 %' in Section 4.1. IDC allocation for extension wiring added.
SIN 351 Issue 2.0	June 2001	Annex B amended to add minimum 2400 bit/s data rate
SIN 351 Issue 3.0	March 2002	Clause 3.1, Off-line d.c. Voltage, examples of discontinuous voltage added. Clause 9.9, Line Sharing, added. Clause 11.2, Future Plans, revised. Clause 4.3, Recall added (clause moved from SIN 354) Editorial changes.
SIN 351 Issue 4.0	September 2002	Information from SIN 249 on Distinctive Ringing added to Annex A. Annex B text on minimum data rate amended.
SIN 351 Issue 4.1	March 2003	Clause 2.2.1 Note. Wording clarified. Clause 9.8 'TE Spectral Power Requirements' – Reference to the RE&TTE Directive, SI No. 730/2000, and SIN 375 added. Annex C Frozen-Set Table corrected to reference PD 6567.
SIN 351 Issue 4.2	February 2005	Editorial changes. Correction to timing characteristics for MF Tone Signalling digit recognition in 4.1. Information added to 3.2 that line current provided by new designs of interface will tend towards 25 mA. Changes to 6.1 to clarify call arrival characteristics. In Annex B, reference to Licence Condition replaced by reference to Statutory Instrument.
SIN 351 Issue 4.3	May 2005	Update to remove reference to withdrawn SINs – reference to SIN 306 in 9.9 (Line Sharing) changed to SIN 346 and reference to SIN 277 removed from Annex C.

SIN 351 Issue 4.4	January 2006	Clause 3.2 (On-Line d.c. Condition) updated. Note added to 6.1 (Call Arrival Indication). Reference to UK National Transmission Plan added to Appendix C.
SIN 351 Issue 4.5	May 2006	Addition of Called Party Answer reversal option to line polarity clause.
SIN 351 Issue 4.6	April 2014	Update to section 7.1.2 – 'a timeout process lasting between two and 3 minutes' changed to 'between 2 *seconds* and 3 minutes'. Editorial changes Change SINet site references from http://www.sinet.bt.com to http://www.btplc.com/sinet/
SIN 351 Issue 4.7	October 2016	Further update to section 7.1.2. Time out process changed from 'between 2 seconds and 3 minutes' to 'between 2 and 3 seconds'
SIN 351 Issue 4.8	October 2017	Minor editorial changes to section 3.2 (deleted redundant bullet) and section 12 (deleted redundant carriage return in reference 4).
SIN 351 Issue 4.9	October 2018	Generic Ethernet Access added to Section 9.9
SIN 351 Issue 5.0	August 2020	Changes made to reflect Openreach branding, updates to Openreach SIN site and Openreach SIN email address.
SIN 351 Issue 5.0	July 2021	Annual Review – no changes required – issue remains unchanged.
SIN 351 Issue 5.0	July 2022	Annual Review – no changes required – issue remains unchanged.
SIN 351 Issue 5.0	September 2023	Annual Review – no changes required – issue remains unchanged.
SIN351 Issue 5.1	November 2024	Service Withdrawal notification added to Section 1.

Annex A: Call Arrival INDICATION (Ringing)

Significance		**Cadence (± 10 %)**
1) Standard Ringing		0.4 s on 0.2 s off 0.4 s on 2 s off **or** 0.35 s on 0.22 s off then start at any point in: 0.4 s on 0.2 s off 0.4 s on 2 s off
2) Distinctive Ringing *(Used to indicate calls arriving from particular supplementary services. See SIN 354 for details of these supplementary services.)*	Type 1	1 s on 2 s off
	Type 2	0.25 s on 0.25 s off 0.25 s on 0.25 s off 0.25 s on 1.75 s off
	Type 3	0.4 s on 0.8 s off
	Type 4	2 s on 4 s off

Note 1: The signal frequency of Standard Ringing and Distinctive Ringing is 25 Hz +1 Hz, -5 Hz.

Note 2: There are certain interfaces supported by non-copper access systems that cannot provide the distinctive ringing signals.

Note 3: Ringing Cadence does not necessarily coincide with ring tone cadence.

Note 4: Suppliers should ensure that devices will not be adversely affected should ringing be applied to them.

Note 5: On some exchanges, Distinctive Ringing Type 1 is preceded by a first cycle of 0.4 s on, 0.2 s off.

Note 6: BT Distinctive Ringing Types 1, 2 and 3 vary slightly from those shown in BS 6305:1992.

Note 7: Distinctive Ringing cannot be provided on small rural digital exchanges (UXD 5).

Note 8: Distinctive Ringing Types 3 and 4 are unused by BT but have been defined for possible future use.

Annex B: Analogue Data Transmission

Successful data transmission

The PSTN was designed for voice traffic; however, it is possible to carry other analogue signals. Digital data may be sent over the PSTN using suitable analogue modulation equipment (modems). Modems are generally designed to obtain the best performance in the prevailing conditions, and the nominal maximum rate for a particular modem can usually only be attained under ideal conditions. These are not always achievable in practice, even though the connection may be fully acceptable for speech. The maximum data rate attainable may therefore vary according to the characteristics of an individual connection, and at any moment in time. For a specified connection, the actual data rate achieved will also depend on the characteristics of the modulation devices, for example the transmitted power level and the modems' tolerance of errors.

Because data transmission performance is subject to many uncontrollable variables, BT does not guarantee data rates over the PSTN, other than to provide "functional internet access" as required by SI 2003 No. 1904[14]†. BT does guarantee the data rate on the ISDN. Most modem connections fully meet customers' expectations, but BT will try to resolve modem problems raised by customers and manufacturers to further improve modem performance over its network. It has been found that most common faults will affect telephony (in this context, the ability to make and clear calls) before they affect modem transmission performance. The major exception is noise, which can affect modem performance more severely than it affects speech.

In September 1998 the ITU-T agreed a recommendation, V.90 [11], for the new generation of 'pcm' modems. However, the modulation techniques introduced in V.90 are substantially different from those in V.34 [12] and, whilst many connections may support higher rates than achieved using V.34, BT cannot guarantee this in all cases.

BT does, and will continue to, comply with its Universal Service Obligation and with European directives.

[†] Guidance on the UK interpretation of the term "functional internet access" is given in the "Designation of BT and Kingston as universal service providers, and the specific universal service conditions, 22 July 2003", originally published by Oftel.

Annex C: Further Sources of Related Information

BT's Network has been designed to support terminal equipment that meets the UK 1992 approval regime.

British Standard	Title	Date
'1992 Standard Set', also known as the 'Frozen Set'	PD 6560; BS 6317; BS 6320; PD 6561; PD 6571; PD 6562; PD 6563; PD 6564; PD 6565; PD 6566; PD 6567; BS 6833 Part 2; PD 6572.	1992

A number of BT SINs are useful in providing background information about the BT network interface.

SIN Number	Title
227	BT Analogue Caller Display Service - Service description
242	CDS™ Calling Line Identification Service. TE Requirements Part 1 Idle State, Down Stream Signalling, Part 2 Loop State signalling
367	Characteristics of the BT Network: Electrical Safety & EMC

Guidance on one-way transmission delay can be found in the Recommended Standard for the UK National Transmission Plan for Public Networks, ND1701. This is published by the Network Interoperability Consultative Committee. For further information or copies of referenced sources, please see document sources at http://www.btplc.com/sinet/Documentsource/index.htm.

– END –